METHOD AND APPARATUS FOR FILTERING AN AUDIO SIGNAL

FIELD OF THE APPLICATION

[0001] The present application relates to apparatus for the processing of audio signals. The application further relates to, but is not limited to, apparatus for recording and processing audio signals.

BACKGROUND OF THE APPLICATION

[0002] Electronic apparatus and in particular mobile or portable electronic apparatus may be equipped with integral microphone apparatus or suitable audio inputs for receiving a microphone signal. This permits the capture and processing of suitable audio signals for processing, encoding, storing, or transmitting to further devices. For example cellular telephones may have microphone apparatus configured to generate an audio signal in a format suitable for processing and transmitting via the cellular communications network to a further device, the signal at the further device may then be decoded and passed to a suitable listening apparatus such as a headphone or loudspeaker. Similarly some multimedia devices are equipped with mono or stereo microphone apparatus for audio capture of events for later playback or transmission.

[0003] The electronic apparatus can further comprise audio capture apparatus which either includes the microphone apparatus or receives the audio signals from one or more microphones and may perform some pre-encoding processing to reduce noise. For example the analogue signal may be converted to a digital format for further processing.

[0004] This pre-processing may be required when attempting to record full spectral band audio signals from a far audio signal source when the desired signals may be subjected to sporadic audio distortions such as such as pops and clicks.

[0005] A typical source of such sporadic audio distortion may be the sound of a camera shutter or the sound of an auto focussing system whilst a video recording is being made. Such distortions are easily picked up microphones embedded within the device before being converted to a digital audio signal by an analogue to digital converter.

[0006] In order to improve the quality of a digital audio signal before recording or any further processing is commenced it is desirable to remove all such sporadic audio distortions.

[0007] Known audio click suppression techniques typically deploy a multistage approach whereby a first stage may detect the click, and then a further stage determines a gain which may be applied to a section of audio signal to attenuate the audio click or pop. However, current approaches adopting multistage stage techniques can distort the section of the audio signal comprising the audio click, as well as providing insufficient attenuation of the audio click.

SUMMARY OF THE APPLICATION

[0008] This application proceeds from the consideration that audio click suppression can deploy a two stage approach, whereby the first stage detects the audio click and the second stage suppresses the audio click. However, such techniques under certain conditions can result in both distortion of the audio signal and insufficient attenuation of the audio click. It is desirable therefore that an audio click suppression system sufficiently attenuates the audio click whilst subjecting the audio signal to a small amount of distortion as possible.

[0009] The following embodiments aim to address the above problem.

[0010] There is provided according to an aspect of the invention a method comprising determining a peak energy level for an audio frame of a band limited audio signal; determining that the peak energy level is a maximum peak energy level by determining that the peak energy level exceeds a peak energy level determined for at least one neighboring audio frame by a first predetermined energy threshold value; classifying a region of audio samples associated with the maximum peak energy level as an audio click; and suppressing audio samples of the region of audio samples classified as an audio click by multiplying at least one audio sample of the audio frame with a sample wise suppressor gain function.

[0011] The sample wise suppressor gain function for the at least one sample of the audio frame may be dependent at least in part upon a ratio of a determined long term tracked signal amplitude value for the audio frame and a sample wise signal amplitude value for the at least one sample of the audio frame.

[0012] The sample wise signal amplitude value for the at least one sample of the audio frame may be dependent on the maximum sample value of a plurality of samples encompassing the at least one sample of the audio frame.

[0013] The determined long term tracked signal amplitude value for the audio frame may be updated on an audio frame by audio frame basis and can be dependent on the combination of a past long term tracked signal amplitude value and a mean absolute amplitude value for the audio frame.

[0014] The determining that the peak energy is a maximum peak energy level further comprises: determining that the peak energy level of the audio frame may be within a second predetermined energy threshold value of an estimated maximum peak energy level for the audio frame.

[0015] The estimated maximum peak energy level may preferably be determined by: weighting a past estimated maximum peak energy level with a first weighting factor; weighting a maximum peak energy level for a previous audio frame with a second weighting factor; and combining the weighted past estimated maximum peak energy level with the weighted maximum peak energy level for the previous audio frame, wherein the first and second weighting factors can control the rate of adaptation of the estimated maximum peak energy level to the peak energy level of the audio frame.

[0016] The determining that the peak energy level is a maximum peak energy level may preferably further comprises determining a signal energy level for the audio frame, wherein the signal energy level is a minimum of the at least one peak energy level determined for the audio frame and the at least one neighboring audio frame; comparing the signal energy level for the audio frame to the estimated maximum peak energy level; and determining that the estimated maximum peak energy level exceeds the signal level by a third predetermined energy threshold value.

[0017] The determining the peak energy level for the audio frame of the band limited audio signal may preferably comprise: determining an energy value for a plurality of consecutive audio samples encompassed within the audio frame; determining a further energy value of a further plurality of consecutive audio samples within the audio frame, wherein the plurality of consecutive audio samples and the further plurality of consecutive audio samples overlap within the